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PROJECT APOLLO END ITEM SPECIFICATION BOILERPLATE NUMBER 12

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14 February 1964 NAS9-150

Paragraph 4.2. Exhibit I.

CLASSIFICATION CHANGE
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SPACE and INFORMATION SYSTEMS DIVISION

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PROJECT APOLLO
END ITEM SPECIFICATION
BOILERPLATE NUMBER 12

1. SCOPE

1.1 Scope. - This specification defines the requirements for a simulated Apollo spacecraft consisting of a launch escape system (LES), command module (CM), and a service module (SM) with extension, hereinafter referred to as Boilerplate Number 12.

1.1.1 Specification Organization. - This specification is organized as follows:

Basic section

Appendix A - Drawings

Appendix B - Process Specifications

Appendix C - Material Specifications

Appendix D - Procurement Specifications

Appendix E - Flight Hardware.

1.1.2 Mission. - The mission of Boilerplate Number 12 is to demonstrate the structural integrity and determine the operational characteristics of the escape system during an abort at high dynamic pressure in the transonic speed range.

1.1.3 Objectives. - The test objectives of the mission are as follows:

(a) First-Order Test Objectives

1. Demonstrate the structural integrity of the escape tower

2. Demonstrate the capability of the escape system to propel the command module to a predetermined distance from the launch vehicle.

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3. Determine aerodynamic stability characteristics of the escape configuration for this abort condition

4. Demonstrate proper operation of the CM to SM separation mechanism

5. Demonstrate proper operation of the parachute recovery system.

(b) Second-Order Test Objectives

1. Demonstrate Little Joe II - spacecraft compatibility

2. Determine aerodynamic loads due to fluctuating pressures on the CM and SM during Little Joe II launch

3. Demonstrate satisfactory abort and recovery timing sequence.

2. APPLICABLE DOCUMENTS

2.1 Applicability. - The following documents of the issue in effect on the date of contract form a part of this specification to the extent specified herein.

2.1.1 Government Documents. -

SPECIFICATIONS

Military

MIL-E-5400	Electronic Equipment, Aircraft, General Specification for
MIL-I-8500	Interchangeability and Replaceability of Component Parts for Aircraft and Missiles, Specification for
MIL-L-6880	Lubricating, Aircraft, General Specification for
MIL-R-27542	Reliability Program Requirements for Systems, Subsystems, and Equipment, Specification for

STANDARDS

MIL-STD-130	Identification Marking of U.S. Military Property

National Aeronautics and Space Administration (NASA)

NPC 200-2	Quality Assurance Provisions for Space Contractors, dated 20 April 1962

2.1.2 Non-Government Documents.

SPECIFICATIONS

North American Aviation, Inc.,
Space and Information Systems Division (NAA/S&ID)

MA 0116-012	Preparation for Delivery and Transport of Apollo Boilerplates, Specification for
MA 0201-0208	Identification and Traceability, Internal Apollo Program, Specification for
MC 999-0002B	Electromagnetic Interference Control for the Apollo Space System, Specification for

OTHER DOCUMENTS

SID 62-109	General Test Plan, Research and Development for Project Apollo Spacecraft Dated March 1963
SID 62-1001	Preliminary Flight Research and Development Instrumentation, Interface Requirements, Specification for
SID 63-143-9	Actual Weight and Balance Report Boilerplate Number 12
SID 63-313	Apollo Master Spacecraft Specification
SID 63-562	Apollo Measurement Requirements Boilerplate 12
SID 63-946	Performance and Interface Specification for Boilerplate Number 12

DRAWINGS

North American Aviation, Inc.,
Space and Information Systems Division (NAA/S&ID)

B14-000002-191	General Assembly, Apollo Complete Boilerplate 12
B14-000024	Finish Specification, Apollo Boilerplate, Complete
B15-000002-131	General Assembly LES 6
B16-000002-101	General Assembly, Command Module
B17-000002-121	General Assembly, Service Module 1

2.2 Precedence. - The order of precedence in case of conflict will be as follows:

(a) The contract

(b) This specification

(c) Other documents referenced herein.

3. REQUIREMENTS

3.1 General. - The following paragraphs delineate the basic requirements for design, fabrication, assembly, and performance for Boilerplate Number 12.

3.1.1 Weight. - Weight, center of gravity, and moments of inertia data for Boilerplate Number 12 shall be as presented in Specification SID 63-143-9.

3.1.2 Materials. - Materials shall be compatible with design, weight, and load criteria.

3.1.2.1 Fabrication. - Structural design concepts of Boilerplate Number 12 emphasize employment of proven manufacturing techniques and methods to the greatest possible extent. Maximum use shall be made of developed "off-the-shelf" components fabricated by dependable manufacturers.

3.1.3 Design Criteria. - Design criteria shall be in accordance with rational design principles as specified in Specification SID 63-313.

3.1.3.1 Electromagnetic Interference. - Electromagnetic interference control shall be in accordance with SID Specification MC 999-0002.

3.1.3.2 Environment. - The environmental design criteria for Boilerplate Number 12 shall be as specified in Specification SID 63-313.

3.1.3.3 Checkout Provisions. - Boilerplate Number 12 shall be designed with provisions for system and integrated systems checkout and test capabilities.

3.1.4 Interchangeability. - Interchangeability as defined for the Apollo Program shall be in accordance with Specification MIL-I-8500 and shall apply to all completely finished assemblies, components, and parts which shall be capable of being readily installed, removed, or replaced without alteration, misalignment, or damage to parts being installed or to adjoining parts. No fabrication operations, such as cutting, filing, drilling, reaming, hammering, bending, prying, or forcing, shall be required for installation.

3.1.4.1 Interchangeability of Electronic Equipment. - Interchangeability of electronic equipment shall be in accordance with Specification MIL-E-5400, where applicable. Interchangeability of electronic equipment for the Apollo Program shall require that mechanical and electrical interchangeability shall exist between like assemblies, subassemblies, and parts regardless of the manufacturer or supplier. Interchangeability for the purpose of the Apollo Program does not mean identity, but shall require that a substitution of such like assemblies, subassemblies, and replaceable parts be easily effected without physical or electrical modification to any part of the equipment, including cabling, wiring, and mounting and without resorting to selection; however, adjustment, trimming, or calibration may be made.

3.1.5 Replaceability. - Replaceability, as defined for the Apollo Program, shall be in accordance with Specification MIL-I-8500 and shall apply to parts which may require additional work or operations during installation. This may include such additional operations as drilling, reaming, cutting, filing, trimming, shimming or other means, normally associated with installing the original assembly into the end item. Replaceable parts shall be designed to permit replacement under field maintenance conditions.

3.1.6 Finish. - Finish requirements shall be as specified in SID Drawing B14-000024.

3.1.7 Identification and Marking. - Identification and marking shall be in accordance with Specification MIL-STD-130.

3.1.8 Identification and Traceability. - Identification and traceability shall be in accordance with the requirements of Specification MA 0201-0208.

3.1.9 Lubrication. - Lubrication of components, where required, shall be in accordance with the requirements of Specification MIL-I-6880. No petroleum-base lubricants shall be used. Lubricants shall be of the silicone base, fluorolube, oxylube 702, and dry film type. Lubrication shall not cause any toxic or flammable substances to occur in the CM or in the environmental control system.

3.1.10 Reliability. - An integrated reliability program, generally in accordance with Specification MIL-R-27542, shall be conducted throughout the design, development, fabrication, and checkout and acceptance of Boilerplate Number 12.

3.2 Configuration. - The configuration of Boilerplate Number 12 is shown in Figure 1. For detailed configuration information, refer to SID Drawing B14-000002-191.

3.2.1 Launch Escape System (LES). - The LES shall consist of the following major components:

(a) Q-ball assembly and ballast enclosure

(b) Pitch control motor

(c) Tower jettison motor

(d) Launch escape motor

(e) Structural skirt

(f) LES tower.

3.2.1.1 Q-Ball and Ballast Enclosure. - The Q-ball and ballast enclosure shall provide for, (1) utilization of a Q-ball configuration and associated interfaces, (2) capability for accommodating 1500 pounds of lead ballast, (3) capability for accommodating a lateral thrust motor mounted approximately normal to the X axis with resultant thrust toward minus Z direction.

3.2.1.1.1 Q-Ball System. - Three differential pressure transducers with associated attachment fittings and electronic wiring shall form the S&ID furnished Q-Ball system. Data acquired from the Q-Ball shall include angle of attack, angle of sideslip, and dynamic ram pressures. The transducers shall be located in the LES nose cone and shall sense airflow direction

and pressure through ports in the nose cone surface. The input voltage shall be approximately 28 volts dc. The transducers shall be capacitive-balanced with conversion of input power to 8 kilocycles. The output of the transducers will be proportional to the three differential pressures measured. The transducer outputs will be applied to the telemetry equipment after amplification and conversion of the outputs to direct current.

3.2.1.2 Pitch Control Motor. - The pitch control motor shall be a solid propellant reaction motor 8.8 inches in diameter and 22 inches in length. The motor shall provide 1700 lb-sec total impulse (about 3400 LBF thrust for about 0.5 sec.) in the minus Z direction producing pitch about the Y axis in the minus Z direction which shall provide lateral displacement. The rocket motor shall be ignited by an igniter which shall utilize redundant hotwire initiators.

3.2.1.3 Tower Jettison Motor. - The tower jettison motor shall be a solid propellant motor 55.6 inches in length and 26 inches in diameter. The motor shall have two fixed thrust nozzles canted 30 degrees from the mean motor centerline. The resultant thrust axis shall be located 2.5 degrees plus or minus 30 minutes from the mean motor centerline of the pitch plane. The jettison motor shall weigh 534 pounds, which includes the interstage structure, shall develop 33,000 pounds of thrust and shall fire for 1.2 seconds. The rocket motor shall be ignited by a pyrogen type igniter which shall utilize redundant hotwire initiators.

3.2.1.4 Launch Escape Motor. - The launch escape motor shall be a solid propellant motor with four nozzles nominally canted 35 degrees from the mean centerline. The resultant thrust vector of 2 degrees 45 minutes plus or minus 15 minutes shall be obtained by a difference in two opposite nozzle throat areas. The motor shall contain 3200 pounds of solid propellant fuel and shall have a gross weight of 4800 pounds. The motor shall be designed for 515,000 LBF seconds total impulse and the effective thrust developed shall be 155,000 pounds at 36,000 feet altitude and 70 degrees Fahrenheit grain temperature. The motor shall be ignited by a pyrogen type igniter which shall utilize redundant hotwire initiators. The motor shall have a burning time of 3.5 seconds at nominal thrust with burnout at 8 seconds.

3.2.1.5 Structural Skirt. - A structural skirt assembly shall be utilized to mount the launch escape motor to the tower. The skirt shall be constructed of a forged ring with longerons, welded to a shear skin, that shall transfer uniform load from the launch escape motor to four points at the launch escape tower legs. The structural skirt shall be bolted to the LES tower.

3.2.1.6 Launch Escape Tower. - The launch escape tower shall be a four-legged welded tubular alloy, truncated rectangular cross-sectioned pyramid, approximately 120 inches in length with a base 46 inches by 50 inches. The tower shall form the intermediate structure between the CM and the launch escape motor. At the top of the tower an aerodynamic flap shall be installed. At the bottom of the tower, four passive tension ties shall be incorporated to attach the tower to the CM forward heat shield. An interface separation device shall be incorporated to attach the tower to the CM forward bulkhead fittings.

3.2.1.6.1 Aerodynamic Flap. - An aerodynamic flap, constructed of sheet aluminum, shall be installed immediately below the structural skirt separation plane. The flap shall be mechanically attached to diagonal tower members parallel to the YY axis and inclined 32 degrees in the minus Z direction. A cutout in the flap shall be compatible with camera installation. The aerodynamic tower flap will function, with the tower, to stabilize the CM blunt heat shield forward during aborts at altitudes between 30,000 feet and 220,000 feet.

3.2.1.6.2 Temperature Sensitive Paint. - Temperature sensitive paint shall be applied, at the test site, to tower members at appropriate locations to acquire LES plume impingment heating data.

3.2.1.7 LES Electrical System. - The LES electrical system shall consist of:

(a) Wiring harness and associated attachments

(b) Hotwire initiators

(c) Launch escape tower sequencers.

3.2.1.7.1 LES Electrical Wiring Harness. - Redundant wiring harnesses shall be bonded to the exterior of the launch escape motor and associated redundant harnesses shall be integral to the tower structure. The wiring harness shall provide the means of connecting the rocket motor and separation circuits with the sequence controllers, and the instrumentation components with the communications equipment. Each tower structure harness shall have a breakaway type plug that shall permit the harness to be detached, at the separation plane, when the launch escape tower is jettisoned.

3.2.1.7.2 LES Hotwire Initiators. - The LES hotwire initiators shall consist of two redundant circuits. One dual circuit shall contain the electrical wiring, initiators, and explosive charges to detonate the tower jettison motor igniters. The other dual circuit shall contain the electrical wiring and hotwire initiators to detonate the explosive bolts required in the LES-CM separation.

3.2.1.7.3 LES Tower Sequencers. - Two LES tower sequencers shall be installed on the underside of the structural skirt. Each tower sequencer shall be 2.5 inches in width, 10.0 inches deep, and 4.0 inches high. The sequencers shall be redundant for increased reliability.

3.2.1.8 LES Pyrotechnic System. - The LES pyrotechnic system shall consist of the following major components:

(a) Pyrotechnic batteries

(b) Electrical wire busses

(c) Hotwire initiators

(d) Pyrotechnic cartridges.

The two pyrotechnic batteries shall be the power source for supplying dc current to the pyrotechnic devices. The electrical wire busses, incorporated in the wiring harnesses, shall carry current from the pyrotechnic batteries to the high resistance hotwire initiators which shall supply current to detonate explosive charges for jettison motor ignition and tower separation. The pyrotechnic system shall be redundant for reliability.

3.2.1.9 LES Umbilical System. - The LES umbilical system shall provide means by which the LES and CM are linked electrically. Two electrical connectors shall join the electrical systems. The connectors shall be located in the separation plane adjacent to an escape tower leg well in the CM forward heat shield. The receptacle portions of the connectors shall be located on the CM. The plug portion of the connectors shall be attached to the nearest tower leg by a lanyard. When the escape tower separates from the CM, the lanyard shall pull the plugs from the receptacles.

3.2.1.10 LES R and D Instrumentation. - The LES R and D instrumentation shall consist of temperature measuring devices. Data acquired by these data devices shall be transmitted to the R and D telemetry equipment by means of the electrical wiring harness for transmission to the ground station. Refer to Figure 6 for LES tower sensor locations.

3.2.1.11 LES Tower - CM Separation System. - The LES tower separation system contains four explosive bolts that secure the tower to the CM. Each bolt shall contain a single mode explosive charge in the center which shall be detonated by the hotwire initiators. Release of the tower shall be accomplished by simultaneous detonation of the four explosive attachment bolts. The hotwire initiators shall be energized by positive 28-volt dc signals received from the tower sequencers. The sequencer shall transmit electrical signals to the tower sequencers through the LES-CM umbilical. To accomplish LES-CM separation and launch escape tower jettison, the tower sequencers shall simultaneously apply detonation signals to the explosive bolt hotwire initiators and to the tower jettison firing units which shall cause motor ignition. The LES tower assembly shall then be released and propelled clear of the boilerplate trajectory. Umbilical cables shall be parted by force on the lanyard-type disconnects when the LES jettison motor accomplishes LES-CM separation.

3.2.2 Command Module. - The CM shall consist of the following:

(2) CM structure

(b) Earth landing system

(c) Electrical power system

(d) Environmental control system (ECS)

(e) R and D communications equipment

(f) R and D instrumentation equipment

(g) Abort sequencer.

3.2.2.1 Command Module Structure. - The CM shall be of conical design, 141 inches high and 154 inches in diameter at the base with a net weight of 9000 pounds. The structure shall be fabricated from aluminum with a skin thickness of 0.190 inch. Attach fittings shall be provided at the forward bulkhead to engage the launch escape tower. The configuration of the CM shall be in accordance with SID Drawing B16-000002-191 and shall be similar to the ultimate spacecraft CM. All equipment in the CM shall be placed as near as possible to the position to be occupied in the ultimate spacecraft CM. The interior of the CM shall be insulated to protect the equipment from exterior thermal loads. The CM structure shall include the following:

(a) Cabin housing

(b) Heat shield structure

(c) Separation system.

3.2.2.1.1 Cabin Housing. - The CM shell shall be constructed of aluminum alloy welded into two subassemblies, (1) the forward crew compartment and (2) the aft crew compartment. The subassemblies shall be bolted together and the aft skirt frames and skin shall be attached by mechanical fasteners. The CM shall be covered with cork insulation material to protect the aluminum structure against overheating. Four glass samples, measuring 0.50 x 4.00 x 5.00 inches, to simulate crew windows shall be affixed to the exterior of the CM at the mold line. These samples shall be analyzed to determine the affect of aluminum and carbon deposits on spacecraft crew windows. The CM mold line shall approximate the spacecraft ablative mold line.

3.2.2.1.2 Forward Bulkhead and Egress Tube. - The forward bulkhead structure shall consist of a double skin with riveted stiffeners. The close-out skin shall be attached to stiffeners by blind fasteners. The egress tube shall consist of a welded sheet tube of aluminum welded to the forward bulkhead. A cover plate shall be bolted to the top of the egress tube.

3.2.2.1.3 Forward Crew Compartment. - The forward crew compartment shall consist of multi-stiffeners welded to the outer skin. The stiffeners shall consist of four main longerons attached to the launch escape tower fittings in the forward bulkhead and terminate in the mid-ring splice joint at the aft end of the forward section of the crew compartment. Several secondary longerons shall be utilized for load transfer from the forward bulkhead to the mid-ring. The remaining stiffeners shall assist the skin in resisting airloads.

3.2.2.1.4 Aft Crew Compartment. - The aft section of the crew compartment shall consist of a sidewall with stiffeners, corresponding to those of the forward section of the crew compartment, from the mating aft section of the crew compartment mid-ring to the machined ring forging at the junction of the sidewall and the floor.

3.2.2.1.5 Apex Forward Compartment Heat Shield Cover. - The apex forward compartment heat shield cover structure shall form the forward section of the CM structure and shall consist of an aluminum alloy skin and stiffeners utilizing riveted and bolted construction. A light weight inner skin shall be used to insure a smooth surface such that the forward compartment cover shall not interfere with the parachute bags or equipment upon ejection. The nose cone will be aluminum, with a glass window in the apex for camera visibility.

3.2.2.1.5.1 Apex Forward Compartment Cover Heat Shield Attachment. The apex forward compartment cover heat shield shall be attached at its aft section to the CM forward crew compartment bulkhead where the four main longerons terminate. This attachment shall be accomplished by means of the four LES tower legs attach and separation explosive bolts. The forward section of the heat shield cover shall be attached to the LES tower structure at approximately Station X_L 34.12 by means of four passive tension tie bolts. The tension tie bolts shall be installed parallel to the X axis and shall be spaced 90 degrees apart circumferentially. Refer to Figure 2 for attachment configuration.

3.2.2.1.5.1.1 Apex Forward Compartment Cover Heat Shield Jettison. - The apex forward compartment cover heat shield shall be jettisoned in the maximum q abort mode as an integral part of the LES tower.

3.2.2.1.6 Access Hatch. - The main hatch shall provide access to the CM interior. The hatch shall be constructed of reinforced aluminum plate and shall be bolted into place. It shall be located in the CM sidewall over the head of the center couch position.

3.2.2.1.6.1 Access Doors. - Access doors shall be provided in the skirt structure for servicing the heat shield attach struts.

3.2.2.1.7 GSE Pickup Attach Points. - Four GSE attach points shall be located on the exterior of the CM at 90 degree intervals immediately aft of the forward bulkhead at Station X_C 77.67. Four other attach points shall be externally located immediately forward of the aft heat shield.

3.2.2.1.8 Temperature Sensitive Paint. - Temperature sensitive paint shall be applied to 18 aluminum discs installed around the pressure orifices. The temperature sensitive paint will provide LES rocket motor plume impingement heating information. The paint shall be applied at the test site.

3.2.2.2 Earth Landing System (ELS). - The earth landing system shall contain the following major components:

(a) ELS sequencer

(b) Drogue parachute subsystem

(c) Pilot parachute subsystem

(d) Landing parachute subsystem.

3.2.2.2.1 ELS Sequencer. - The ELS sequencer shall control apex cover separation, drogue parachute deployment, drogue parachute disconnection, pilot parachute deployment. The ELS sequencer shall consist of relays, baroswitches, and timing devices. The 25,000 ft. baroswitches will be electrically by-passed, but instrumented, for Boilerplate Number 12 mission.

3.2.2.2.2 Parachute Subsystem Description. - The CM shall be equipped with a parachute subsystem and consist of:

(a) A drogue parachute subsystem

(b) Three main landing parachutes in cluster including pilot parachutes

(c) Drogue and main parachute riser and harness assemblies

(d) Drogue and main parachute disconnects

(e) A completely redundant sequence controller.

3.2.2.2.3 Parachute Subsystem Design. - The parachute subsystem shall be designed to decelerate and safely land a CM weighing up to 9,500 pounds (after ejection of the apex forward compartment cover) following mission abort conditions.

3.2.2.2.4 Drogue Parachute Subsystem. - The drogue parachute subsystem shall consist of the following:

(a) Drogue parachute

(b) Drogue parachute deployment bag

(c) Drogue parachute mortar assembly

(d) Drogue parachute risers

(e) Drogue parachute disconnect assemblies

(f) Drogue mortar pyrotechnic cartridges.

3.2.2.2.4.1 Drogue Parachute. - The drogue parachute shall be a mortar-deployed, conical-FIST, ribbon design 13.7 feet in diameter, which will exert a maximum load of 10,000 pounds on the CM.

3.2.2.2.4.2 Drogue Parachute Deployment Bag. - The drogue parachute deployment bag shall enclose and protect the drogue parachute and risers while contained in the drogue mortars and during ejection. The deployment bag shall control the parachute and risers to insure orderly deployment of the parachute into the airstream.

3.2.2.2.4.3 Drogue Parachute Mortar Assembly. - The drogue parachute mortar shall contain a drogue parachute and riser packed in a deployment bag, and shall eject the package into the airstream to provide positive deployment of the drogue parachute.

3.2.2.2.4.4 Drogue Parachute Risers. - The drogue parachute risers shall be of sufficient length to place the drogue parachute in a favorable position, with respect to the airstream and blanketing by the CM, to insure full deployment of the drogue parachute.

3.2.2.2.4.5 Drogue Disconnect Assemblies. - The drogue disconnect assemblies shall connect the drogue parachute risers to the CM. The disconnect assemblies shall release the drogue parachute risers upon signal from the sequencer control system.

3.2.2.2.4.6 Drogue Mortar Pyrotechnic Cartridge. - Drogue mortar pyrotechnic cartridge shall provide the necessary propulsive force to eject the drogue parachute package a sufficient distance to provide full deployment of the drogue parachute.

3.2.2.2.5 Pilot Parachute Subsystem. - The pilot parachute subsystem shall consist of three pilot parachutes contained in separate mortars. Each pilot parachute assembly shall consist of the following:

(a) Pilot parachutes

(b) Pilot parachute deployment bags

(c) Pilot parachute mortar assemblies

(d) Pilot parachute risers

(e) Pilot parachute mortar pyrotechnic cartridges.

3.2.2.2.5.1 Pilot Parachutes. - The pilot parachute subsystem shall include three independent pilot parachutes each capable of extracting a main parachute into the airstream.

3.2.2.2.5.2 Pilot Parachute Deployment Bags. - The pilot parachute deployment bags shall contain and protect the pilot parachutes prior to and during ejection from the pilot mortars. They shall also control the deployment of the pilot parachute risers and pilot parachutes.

3.2.2.2.5.3 Pilot Parachute Mortar Assemblies. - The pilot parachute mortar assemblies shall contain and eject pilot parachutes upon signal from the sequence controller.

3.2.2.2.5.4 Pilot Parachute Risers. - The pilot parachute risers shall restrain the pilot parachutes during deployment and operation. The risers shall be of sufficient length to place the pilot parachutes in the airstream.

3.2.2.2.5.5 Pilot Parachute Mortar Pyrotechnic Cartridges. - The pilot parachute mortar pyrotechnic cartridges shall provide the propulsive force necessary to eject the pilot parachutes and risers, as packed in the pilot mortar, to a distance sufficient to allow the pilot parachute to inflate and deploy the main parachutes.

3.2.2.2.6 Landing Parachute Subsystem. - The landing parachute subsystem shall consist of three main parachutes contained in separate packs. Each pack assembly shall consist of the following:

(a) Main parachute

(b) Main parachute deployment bag

(c) Main parachute riser

(d) Main parachute pack retention flap.

3.2.2.2.6.1 Main Parachutes. - The three main parachutes shall be extracted from the packs in a reefed condition and shall remain in that condition, due to a pyrotechnic timer sequence, for six seconds when they shall be disreefed.

3.2.2.2.6.2 Main Parachute Deployment Bags. - The three main parachute deployment bags shall contain and protect the individual main parachute and riser prior to and during extraction from the CM. They shall insure orderly deployment of the parachutes and risers.

3.2.2.2.6.3 Main Parachute Risers. - The three main parachute risers shall be of sufficient length to place the individual main parachutes in the air-stream to insure functional effectivity.

3.2.2.2.6.4 Main Parachute Pack Retention Flap. - The main parachute pack retention flaps shall retain the main parachute and vehicle harness prior to deployment.

3.2.2.2.6.5 Landing Parachute Harness Assembly. - The landing parachute cluster harness assembly shall attach to the four parachute attach fittings on the CM forward bulkhead and extend to the main parachute disconnect assembly. The distance from the parachute attach fitting plate to the disconnect assembly shall be 120 inches measured along the centerline of the harness assembly. The harness assembly shall allow the CM to hang at 5 degrees plus or minus 0.5 degree from the vertical. The harness assembly shall maintain a continuous loop between the parachute attach fittings after operation of the disconnect.

3.2.2.2.6.6 Reefing Cutters. - A minimum of three reefing line cutters, for redundancy, shall be used on each main parachute reefing line. Each cutter shall be capable of being armed at loads consistent with the minimum dynamic pressure deployment conditions. Consideration shall be given to possibilities of inadvertent arming during parachute packing.

3.2.2.3 Electrical Power System. - The electrical power system will consist of one 120-Ampere hours and seven 5-Ampere hours Eagle-Picher, silver-zinc batteries. The 120-Ampere hours battery will be connected to instrumentation busses A & B. Two 5-Ampere hours batteries will be connected to separate pyrotechnic busses, and two 5-Ampere hours batteries will be the power source for the separate logic busses controlling pyro circuits. Three 5-Ampere hours batteries will be provided for the camera system.

3.2.2.4 Environmental Control System (ECS). - The ECS shall be an equipment cooling system designed to provide a heat sink for the thermal loads within the CM. The cooling system shall provide cooling for one RF telemetry package and two Research and Development C-Band transponder units by means of four coldplates connected in series. The system shall be used to maintain temperatures of not more than 100 degrees Fahrenheit during ground operations. The system shall consist of a water reservoir, a pump for circulation, and four coldplates.

3.2.2.4.1 ECS Design. - The ECS for Boilerplate Number 12 shall be a specially designed water tank of 75 pounds water capacity which shall provide coolant for the four cold plates. The coolant out of the water tank shall be circulated by an electric motor-pump combination which shall operate on 28 vdc through an inverter. The inverter shall deliver three phase 400 cycle, 115 volt current to the electric motor.

3.2.2.4.1.1 ECS Instrumentation. - The pressure shall be monitored at the outlet from the coolant pump. A test point for temperature readings shall be installed at the inlet of the first set of cold plates. Another temperature test point shall be installed at the outlet side of the last cold plate.

3.2.2.4.1.2 ECS Flow Rate. - The coolant out of the pump shall flow at the rate of four gallons per minute.

3.2.2.4.1.3 Filling Characteristics. - The coolant tank shall be filled by means of a quick disconnect device which shall be connected to a fill-tank provided by GSE. The coolant shall not exceed 70 degrees Fahrenheit at the time of filling the tank.

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3.2.2.5 Research and Development (R and D) Equipment. - The R and D equipment will provide a means of acquiring data pertinent to the mission of Boilerplate Number 12. Acquisition will be by means of on-board tape recorders and RF telemetry transmission. Refer to Figure 3 for R and D Equipment Block Diagram and Appendix E for detailed list of R and D equipment. Refer to Specification SID 63-562 for measurements list.

3.2.2.5.1 RF Electronic Equipment. - The RF telemetry equipment for Boilerplate Number 12 will consist of an IRIG PAM/FM/FM system containing a power supply, sixteen subcarrier oscillators, one 90 x 10 commutator, one mixer, one transmitter, one five point calibrator, one RF power amplifier, and an antenna system. The telemetry transmitter will have a total power output of 10 watts. For a detailed listing of RF equipment refer to Appendix E.

3.2.2.5.2 Data Equipment. - The primary data gathering device will be an on-board tape recorder. In addition to recording 90 x 10 commutator information and all T/M continuous channels, those measurements requiring high-frequency response will be tape recorded. The tape recorder unit will consist of a tape recorder and tape recorder electronics and a remote control box. Capacity will be 750 feet of 1-inch tape operated at 15 IPS with approximately 10 minutes recording time.

3.2.2.5.3 Antenna Equipment. - The R and D antenna system shall consist of, (1) the telemetry antenna system and (2) the beacon antenna systems. For detailed listing of antenna components refer to Appendix E .

3.2.2.5.4 Telemetry Antenna System. - The R and D telemetry antenna system shall consist of four slot antennas. These shall be located just below the separation line of the forebody apex section of the CM and shall be spaced 90 degrees apart.

3.2.2.5.5 Beacon Antenna System. - The R and D beacon antenna system shall consist of four helix, cavity back antennas to relay C-Band Transponder signals. They shall be mounted on the CM periphery at Station X_c 77.00 and spaced 90 degrees apart.

3.2.2.5.6 C-Band Transponder. - Two C-Band transponders will be installed in Boilerplate Number 12 to permit accurate tracking. Each beacon will operate independently and will be power divided into two helix, cavity back, antennas.

3.2.2.6 R and D Instrumentation. - A telemetry system will provide means of data acquisition from the boilerplate during flight. A telemetry station will be positioned on the ground for the flight. A PAM/FM/FM system will be used for telemetry communications. Instrument installation configuration for the CM is shown in Figure 1. See SID 62-1001 for R and D instrumentation.

3.2.2.6.1 R and D Instrumentation Equipment. - The instrumentation end instruments will consist of, but not be limited to, thermistors, crystal accelerometers, and pressure transducers. Signal conditioning equipment will consist of bridge adjust units, thermocouple compensators, frequency converters, and phase sensitive demodulators. These signal conditioning devices will shape the information received from the sensors into a modulation voltage for the subcarrier oscillators. The amplifier portion will have the capability of being remotely calibrated for both R (range -85 percent full scale) and Z (zero -15 percent full scale). The instrument sensor locations are shown in Figures 4 and 5.

3.2.2.7 Abort Sequencer. - The abort sequencer shall provide a sequenced abort mode that shall be compatible with the Little Joe II thrust termination. The sequencer shall include destruct systems A and B, completely isolated and redundant, consisting of abort lockout relay and abort hot line relay. Radio destruct receivers installed in the Little Joe II booster shall provide the input signals to the relays in the abort sequencer. The sequence events for the abort sequencer shall be as follows:

(a) GSE pre-launch arming signals

(b) Abort lock-out relay activate

  (1) LES logic bus armed
  (2) LES and ELS pyro busses armed

(c) Activate abort hot line relay

(d) Lift-off

(e) Abort lock-out relay deactivated

(f) Radio command to Little Joe II - destruct

  (1) Fire LES and pitch control motors

(g) Start 15.5 second timers

  (1) Relay fires CM-SM separation squibs
  (2) Fire tower jettison motor

(h) Start 3.0 second timers

(i) Signal to tower sequencers

(j) Signal to ELS sequencer.

[redacted]

3.2.2.8 R and D Cameras. - Three motion picture cameras will be installed in advantageous positions to monitor specific events. The camera locations and events to be monitored are delineated in the following list:

(a) A camera will be mounted in the dome of the egress hatch and will view apex forward compartment cover separation, LES motor firing, LES tower separation, drogue parachute deployment, and main parachute deployment through a window in the apex forward compartment cover. The camera will be started at LES motor ignition.

(b) Another camera will be mounted in an armored case located in the center of the SM. This camera will be positioned to monitor smoothness of separation and possible secondary contact by observing light gap at the separation line of the CM and SM. A target will be painted on the CM aft heat shield as a visual aid for this observation. The camera will be started at boilerplate lift-off.

(c) The third camera will be mounted in an armored case located in the ring of the LES tower viewing downward. This camera will view LES motor exhaust plume pattern, changes in exhaust plume pattern due to changing angles of attack, and exhaust plume proximity to the CM. The camera will be started at boilerplate lift-off.

3.2.2.9 CM-LES Tower Separation System. - Release of the LES tower shall be accomplished by simultaneous detonation of four explosive bolts that secure the tower to the CM. Hotwire initiators shall be used to detonate each of the explosive bolts. The hotwire initiators shall be actuated by positive 28 volt dc signals from the tower sequencers relayed from the abort sequencer. To accomplish tower jettison, the tower sequencers shall simultaneously apply detonation signals to the explosive bolts and trigger signals to the tower jettison motor firing units. The LES tower assembly and the apex forward compartment heat shield, as described in Paragraph 3.2.2.1.5.1.1, shall then be released and propelled clear of the CM trajectory. Umbilical cables will be parted by force of the tower jettison motor thrust by exerting strain on the lanyard electrical receptacle disconnect devices.

[redacted]

3.2.3 Service Module. - The SM for Boilerplate Number 12 shall be of boilerplate configuration. Provisions for ballasting the SM, as required, shall be incorporated in the SM structure.

3.2.3.1 Service Module Structure. - The SM structure shall be 124 inches in length and consist of an aluminum skin, with longerons and frames constructed of low carbon steel. Six compression bearing points shall be provided, all capable of withstanding shear loads and compression loads. The SM structure shall be attached to the CM by three tension ties spaced 120 degrees apart.

3.2.3.1.1 Service Module Extension. - An extension shall be attached to the lower end of the SM structure. Its length shall be 10 inches and shall be constructed to mate with the SM and Little Joe II booster.

3.2.3.1.2 SM Protective Bulkhead. - A protective bulkhead made of laminated fiberglass shall be attached to the lower ring in the SM extension. This bulkhead shall be installed as a means for protecting the CM during explosive termination of the Little Joe II powered flight.

3.2.3.2 R and D Instrumentation. - The R and D instrumentation for Boilerplate Number 12 SM will consist of eight pressure transducers. For location of these transducers, see Figure 4. Lines to transmit, to the telemetry equipment, Little Joe II Algol engine throat pressure data and to signal relay closure for Little Joe II thrust termination shall be routed through the SM structure.

3.2.4 Separation System CM-SM. - The CM shall be mated to the SM on six hard pads which shall be capable of withstanding shear and compression loads. Positive attachment shall be obtained by utilizing three preloaded retractable tension tie devices which shall be secured to the aft portion of the CM and to the upper beam of the SM. Separation of the modules shall be accomplished by severing the tension tie devices by means of redundant flexible linear shaped explosive charges which shall be attached to the tension ties. In the abort mode, the abort sequencer shall energize hotwire initiators that shall detonate the explosive charges.

3.2.5 Little Joe II Launch Vehicle. - The Little Joe II Launch Vehicle data are not a requirement of this End Item Specification. Data supplied herein are for informational purposes only and to establish continuity of events leading up to CM transonic abort.

3.2.6 Launcher. - The launcher will be a fabricated steel structure using heavy I-beams for the main supports. Components will include a pivot frame mounted on double-flange, crane-type trucks for rotation to required azimuth positions, a support platform incorporating pads and pins for vehicle support, screwjacks for tilting the support platform to required

elevation angles, and a launch mast. The mast, attached to the support platform, will incorporate two stabilizing support arms for the vehicle and a support arm for the payload umbilical harness. Two A-frames will attach to the pivot frame and will support the platform hinge points. The launcher will be remotely adjustable for elevation and azimuth positions. The elevation attitude will have the capability of being held within plus or minus 1/4 degree and the azimuth bearing will have the capability of being held within plus or minus 1/2 degree. Adjustments will be made for launchings at azimuth angles of plus or minus 45 degrees from some nominal direction and for elevations of from 75 to 90 degrees vertical.

3.3 Performance. - The LES will lift the CM off the launch vehicle and translate the CM to a safe distance from the launch vehicle. Design of the LES shall permit all resultant motion to be within the limits of human tolerance and provide satisfactory conditions for the deployment of the recovery system. The recovery system will be capable of being jettisoned in normal operation. Refer to SID 63-946 for performance requirements.

3.3.1 Launch Abort Mission. - A radio command abort signal will be transmitted to the LES from the Little Joe II radio command receiver and will actuate the abort sequencer in the CM. Launch escape motor ignition, pitch control motor ignition and CM-SM separation will occur. After a timed interval, jettison motor ignition and launch escape tower release will occur simultaneously. The expended LES will follow a free fall trajectory to earth impact. After a timed interval, the drogue parachute will be deployed and will assist in stabilizing the CM blunt end forward for main parachute deployment. After another timed interval, the drogue parachute will be released and the pilot parachutes will deploy the three main parachutes, which will be inflated in a reefed condition. After another timed interval, the three main parachutes will be disreefed, fully inflated, and establish an equilibrium descent velocity of approximately 24 feet per second.

3.3.2 Trajectory Parameters. - Trajectory parameters are listed in Table I.

3.3.3 Flight Plan. - Boilerplate Number 12 will be launched by a Little Joe II booster powered by one Algol and six Recruit Rocket Motors. The Recruit Rocket Motors have a short burning time (1.7 seconds) and will provide a high lift-off acceleration. The Algol motor thrust will be terminated at t + 30 seconds upon ground command signal to the Little Joe II receivers. Thrust termination will occur by detonating a shaped explosive charge which will split the motor casing. At the approximate point of maximum q (t + 30.0 plus or minus 0.5 sec.) the abort sequencer,

[redacted]

through dual radio command signals from the Little Joe II booster, will simultaneously, (1) energize the circuit which will ignite the CM-SM separation system, (2) ignite the escape motor and pitch control motor, and (3) start the 15.5 second timer. The escape configuration will then separate from the Little Joe II Launch Vehicle and after escape motor burnout (t + 38.5 sec.) will continue on a coasting trajectory. At t + 45.7 seconds, the tower jettison motor will be ignited, the ELS sequencer armed and the LES tower and apex forward cover separated from the CM. At t + 48.7 seconds, the drogue parachute will be deployed to stabilize the CM blunt end forward for main parachute deployment. At t + 94.8 seconds, the three main parachutes will be deployed by the pilot parachutes and inflated to a reefed condition to reduce opening shock to the main parachute. At t + 100 seconds, the CM will be in equilibrium descent with the main parachutes fully inflated and descent velocity of approximately 24 feet per second. CM impact will occur at approximately t + 448 seconds and 21,500 feet range (no wind). The LES tower will impact at approximately t + 109 seconds. The Little Joe II and SM will impact at approximately t + 116 seconds at a nominal range of 12,500 feet.

4. QUALITY ASSURANCE

4.1 General QualityAssurance Provisions. - The principal contractor (S&ID) shall be responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the principal contractor may utilize his own or any other inspection facilities and services acceptable to the NASA. Inspection records of the examinations and tests shall be kept complete and available to the NASA as specified in the contract.

4.2 Principal Contractor's Quality Assurance Program. - The principal contractor shall establish a quality assurance program in accordance with the requirements of Paragraph 2.5 of Exhibit A of the contract. Inspections and tests to determine conformance of Boilerplate Number 12 to contract and specification requirements shall be conducted prior to submission of the article to the NASA for acceptance.

4.2.1 Reliability Data. - The principal contractor shall act as a test historian and accumulate applicable data on spacecraft tests, plans, and performance from preparation to delivery. The data shall be used in qualitative and quantitative assessments of reliability and performance of each system, and of the ultimate spacecraft. This data, together with other appropriate data, such as acceptance data, shall be integrated with

that accumulated from prior tests to form assessments. Thus, a probability of success may be developed for any given phase of the mission.

4.3 Examination. - Each assembly and all major components submitted for acceptance shall be subjected to a visual examination to determine conformance to materials, design, construction, dimensions, color and finish, product marking, and workmanship.

4.3.1 Components. - The principal contractor shall ascertain that, prior to assembly, all parts, components, assemblies, and systems procured under separate specifications or drawings have been inspected, tested, and accepted in accordance with their respective specifications or drawings.

4.4 Tests. - Each assembly, major component, and system submitted for acceptance shall be subject to performance tests as specified in applicable documents including SID 62-109.

5. PREPARATION FOR DELIVERY

5.1 Preservation, Packaging, and Packing. - Preservation, packaging, and packing shall be in accordance with the principal contractor's procedures specified in SID Process Specification MA 0116-012.

6. NOTES

None

TABLE 1

SUMMARY OF BOILERPLATE NUMBER 12 TRAJECTORY PARAMETERS

	Flight Sequence	Time t (Sec)	Altitude h (ft)	Dynamic (Pres.) q (psf)	Velocity V (fps)	Mach No.	Range R (ft)	Flight Path Angle (Deg)	Axial Acceleration Ax (g's)
1.	Launch	0	4,066	0	0	0	0	84	4.6
2.	LES Abort Initiation	30.2	20,700	585	---	.94	6,900	56	.5
3.	LES Tower Jettison	45.7	27,800	82	---	.42	16,000	10	---
4.	Drogue Parachute Deployment	48.7	27,850	66	---	.36	17,150	-5	---
5.	Main Parachutes Initiated	97.0	14,350	65	---	.27	21,400	-90.0	---
6.	Equlibrium Descent Main Parachutes Inflated	104.2	13,600	---	25	---	21,400	-90.0	0
7.	Command Module Impact	488	4,000	---	25	---	21,400	-90.0	---
8.	LJ II + SM Impact	116	4,000	67	---	.23	12,400	-90.0	---
9.	Tower Impact	109	4,000	250	---	.44	28,000	-89	---

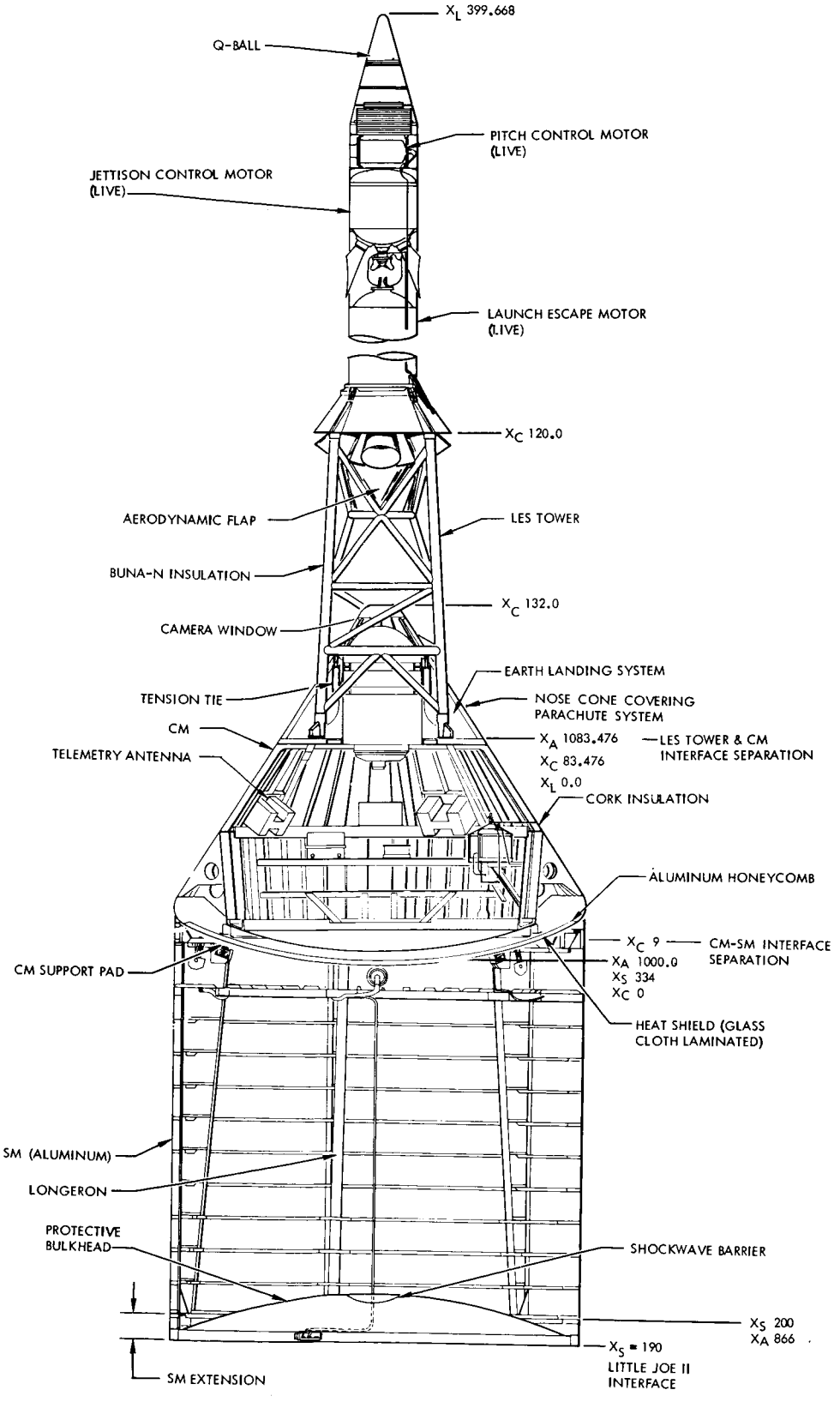

Figure 1. Configuration Boilerplate 12

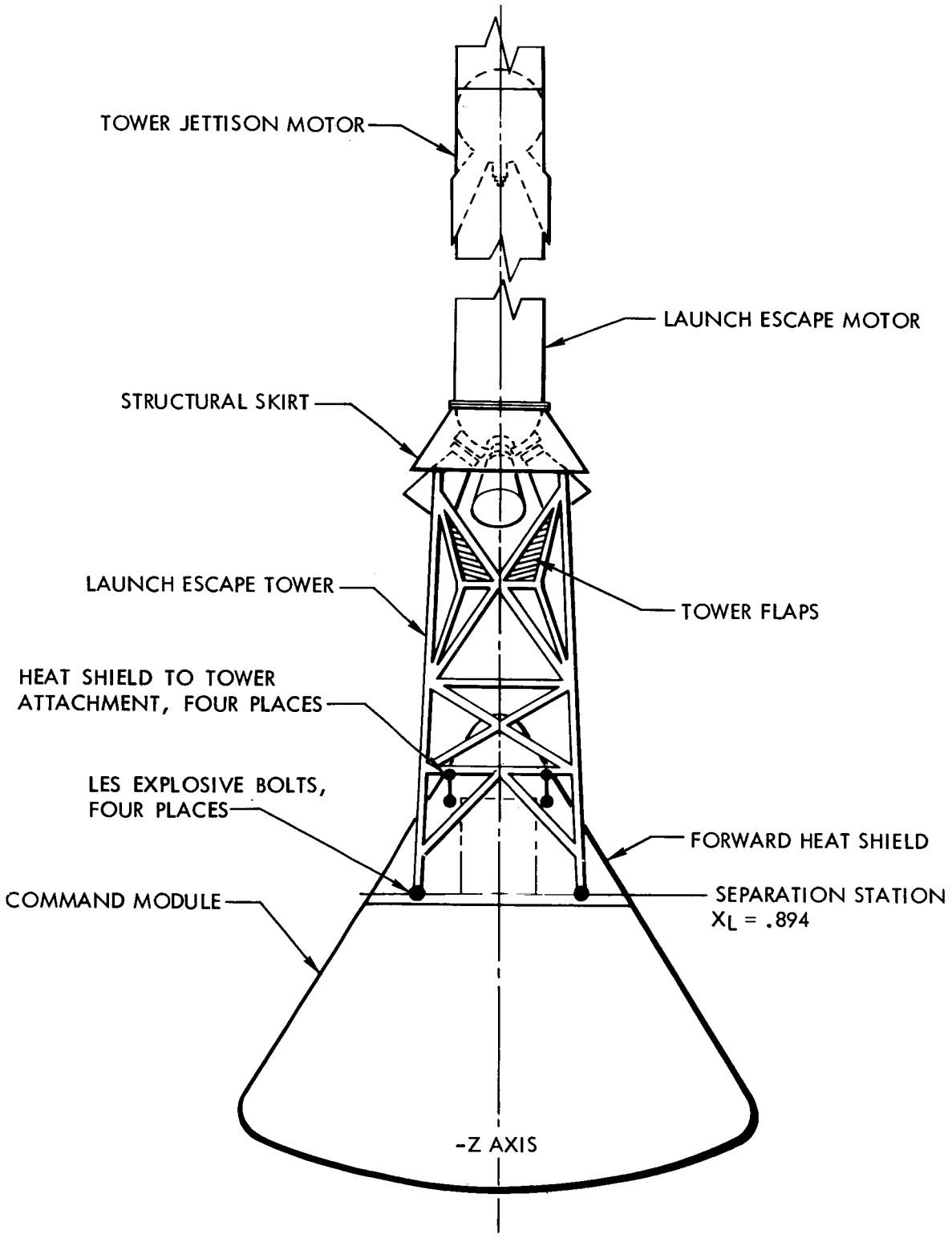

Figure 2. Apex Forward Compartment Heat Shield Attachment to LES Tower

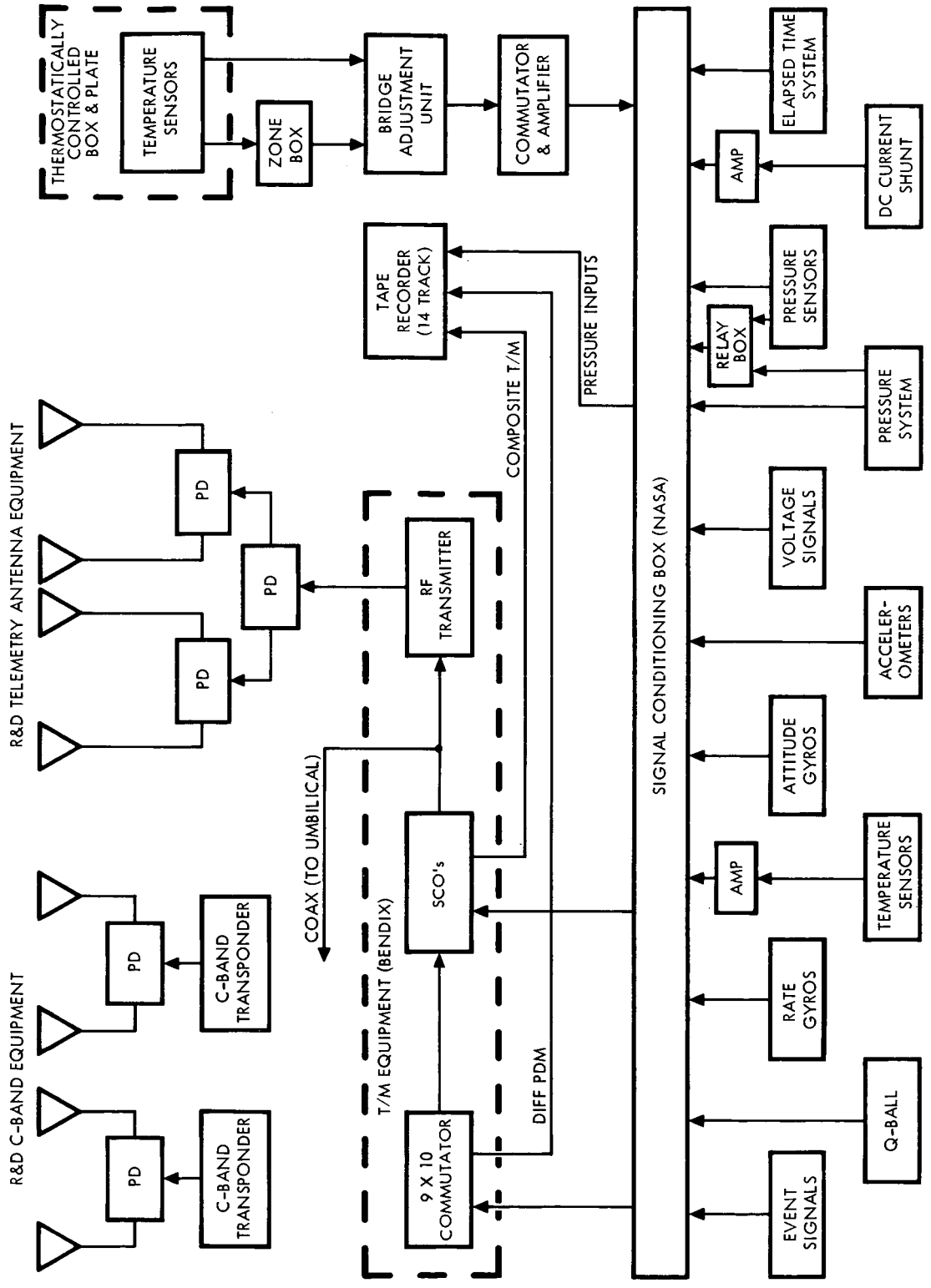

Figure 3. R and D Telemetry Block Diagram

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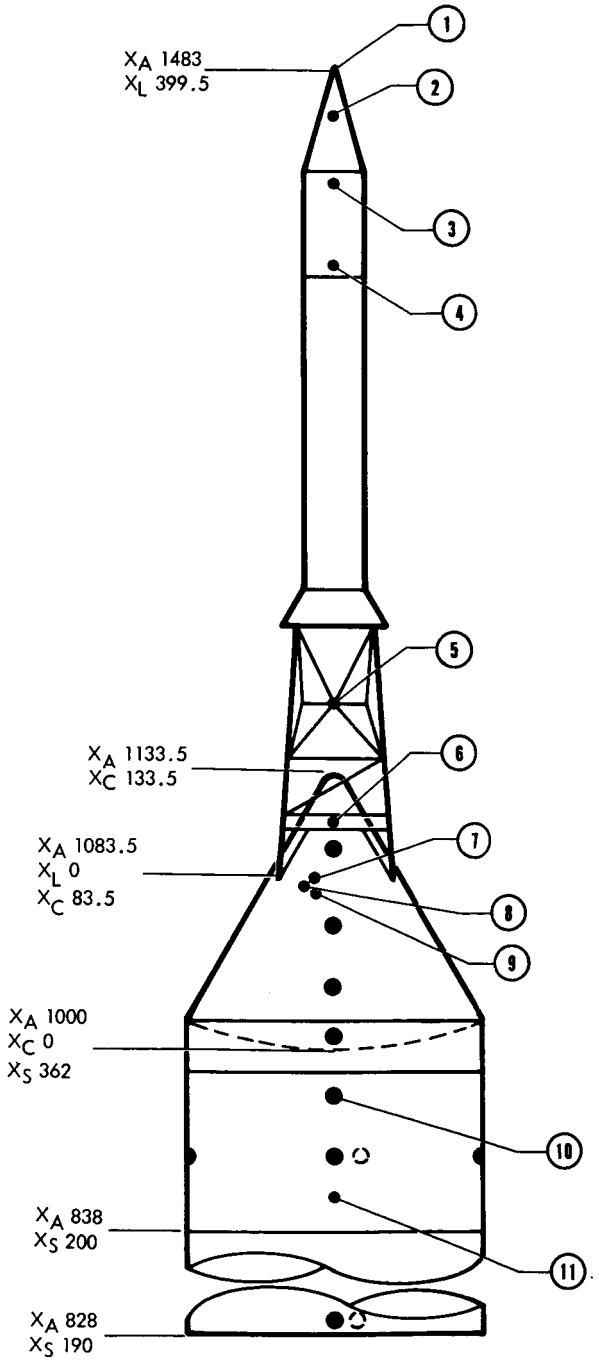


1. Q-BALL (1) (THREE DIFFERENTIAL PRESSURE TRANSDUCERS, PART OF NOSE CONE).
2. ACCELEROMETERS (2) (Y-AXIS X_L380, Y_L0, Z_L6), & (Z-AXIS X_L380, Y_L6, Z_L0).
3. PITCH CONTROL MOTOR CHAMBER PRESSURE (1) (X_L345, Y_L0, Z_L-13).
4. LAUNCH ESCAPE MOTOR CHAMBER PRESSURE (1) (X_L290, Y_L0, Z_L0).
5. LAUNCH ESCAPE TOWER CAMERA (1)(X_L85).
6. COMMAND MODULE CAMERA (1) (X_C124).
7. ACCELEROMETER (4) (INSIDE C/M ($X_C78.5$, Y_C0, Z_C21).
8. RATE GYRO (1) (THREE AXIS PKG. INSIDE C/M ($X_C78.5$, Y_C0, Z_C21).
9. ATTITUDE GYRO (3) (INSIDE C/M ($X_C78.5$, Y_C0, Z_C21).
10. PRESSURES-FLUCTUATING (12).

    (1 AT X_C119, ON CM 355°)

    (1 AT $X_A = 930$ ON SM 357°)

    (2 AT $X_C = 12$ ON S/M 177° & 357°)

    (1 AT $X_C = 70$ C/M 357°)

    (2 AT $X_A = 881$ ON S/M 177° & 357°)

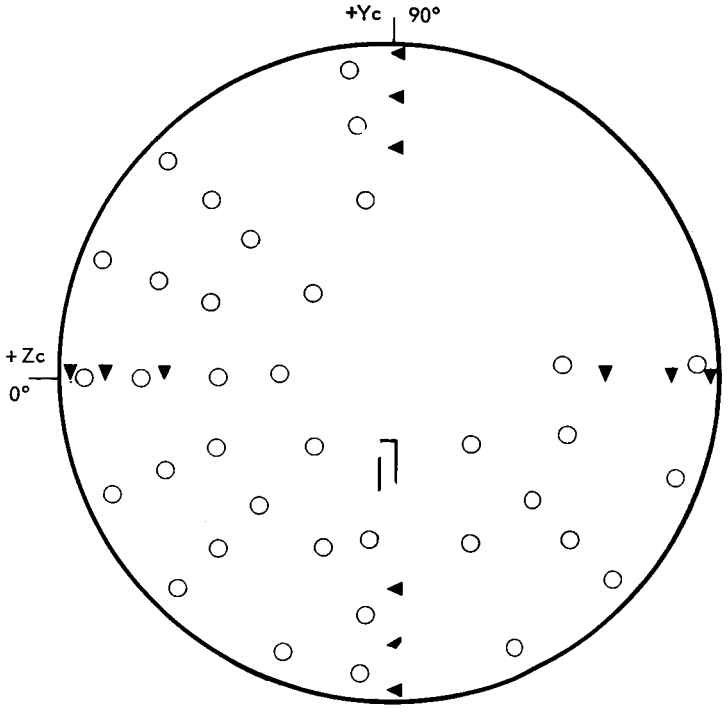
    (4 AT $X_A = 974$ ON S/M 87°, 177°, 267°, & 357°)

    (1 AT $X_C = 40$ ON C/M 357°)

11. SERVICE MODULE CAMERA (1) (X_A870)

Figure 4. Sensor Locations

[redacted]



VIEW LOOKING AFT

PRESSURES (40) (4 ON BASE OF C/M 90° APART).

(12 AT X_C30)

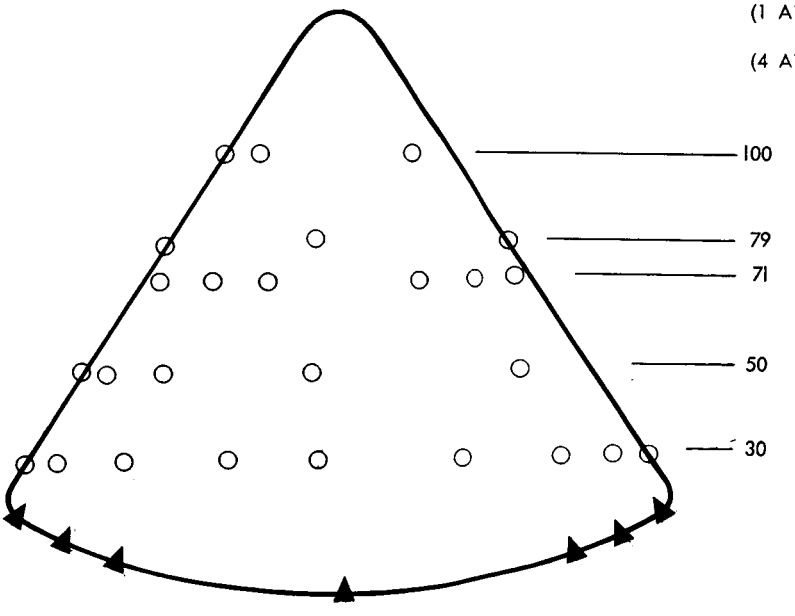
(8 AT X_C50.5)

(8 AT X_C71)

(3 AT X_C79)

(1 AT X_C80.3)

(4 AT X_C100)



SIDE VIEW

Figure 5. Sensor Locations - CM

[redacted]

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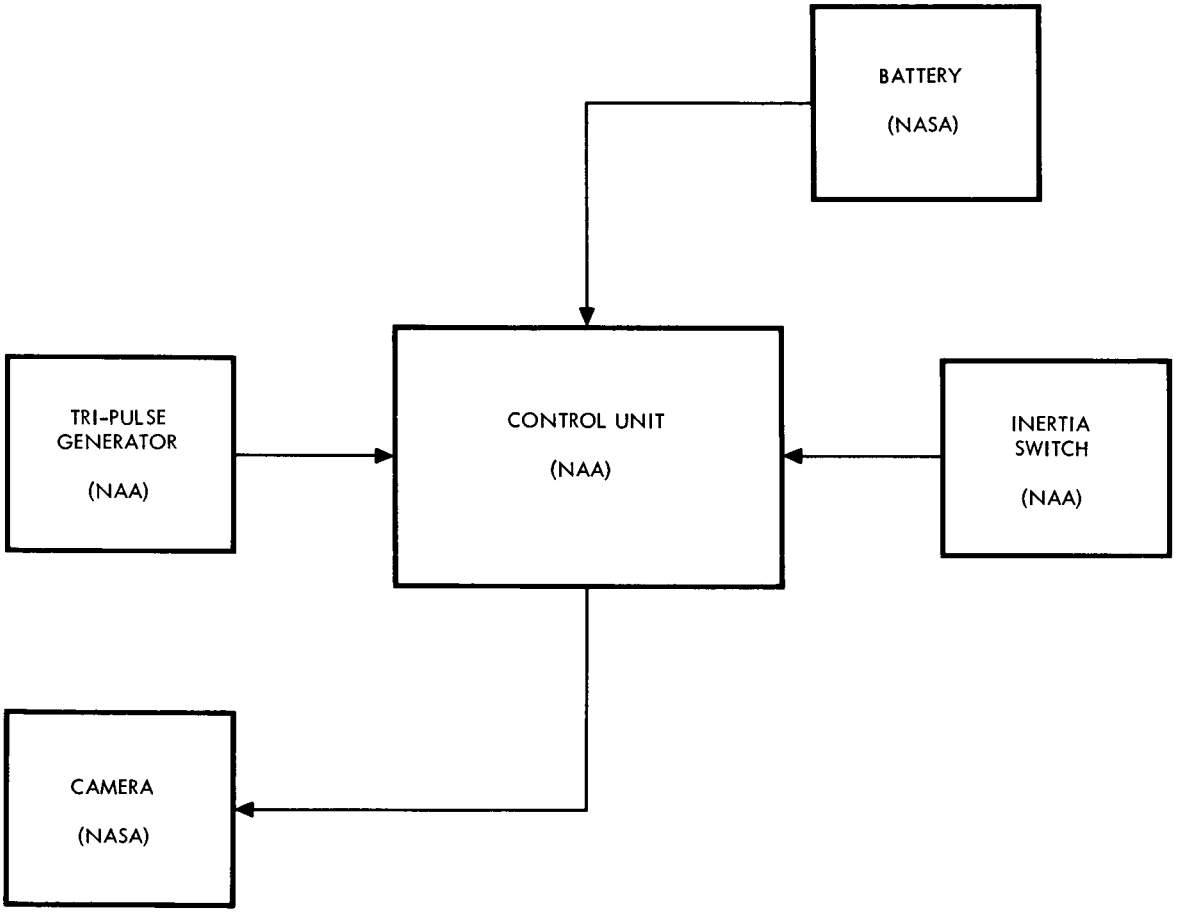

Figure 6. Camera System Block Diagram

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APPENDIX A

DRAWINGS

1. Scope. - The following list constitutes the drawings for Boilerplate Number 12. Only the top drawings for major items are reflected in the list.

Nomenclature	Number
General Assembly, B/P 12	B14-000002-191
General Assembly, LES 6	B15-000002-131
Body Group Assembly	V15-300001-101
Tower Assembly	V15-300100-61
Structure Assembly	V15-300408-91
Power System Installation	B15-400001-31
Rocket Motor Set	B15-410001-11
Electrical System Installation	B15-450012
Electrical Installation - LET	B15-451501
Electrical Installation LE Motor	B15-451510
ECS System Installation	B15-700012
Instrumentation Installation	B15-750012
General Assembly, CM 12	B16-000002-191
Structure-Complete, CM 12	B16-300012
Structure, Assembly of	B16-301006-501
Forward Bulkhead	B16-301073-601
Simulated System Installation	B16-306040
Fairing - Prop Lines	B16-306076
Aft Crew Compartment Structure	B16-311006
Strake Installation	B16-320050-11
Forward Cover, Assembly of	B16-326003-701
Aft Heat Shield	B16-327006-111
Ballast Installation	B16-331097
Parachute Installation	B16-576003
Separation System Forward Cover	B16-596111-501
Mechanical Installation - Main Parachute Riser	V16-576111
Electrical Installation	B16-450012
Electrical Crew Compartment	B16-451501
Electrical Forward Compartment	B16-456501
Electrical Aft Compartment	B16-457501
Electrical Heat Shield	B16-456551

APPENDIX A (continued)

DRAWINGS

Nomenclature	Number
Cooling System Installation	B16-610101
	B16-700012
Antenna Installation	B16-710102
Instrumentation Installation	B16-750012
Recorder Assembly	B16-754000
General Assembly, SM 1	B17-000002-121
Structure - Complete	B17-300012
Structure Assembly	B17-320001-101
Structure Extension	B18-320014
Ballast Installation	B17-320019
Electrical Installation, Complete	B17-450012
Electronic Control System	B17-700012
Communication and Instrumentation Installation	B17-750012

APPENDIX B

PROCESS SPECIFICATIONS

1. Scope. - The following list constitutes the process specifications for Boilerplate Number 12. Section I lists General Process Specifications, Section II lists Specific Process Specifications.

SECTION I

Number	Title
AA0109-012	General Procedure for Brush Type Electro-plating
FA2-90	Sealing Electric Terminations Subject to Temperatures up to 300°F.
FA6-12	Rubber Stamp Markings, Application of
FA6-78	Stenciling Miscel. Marking Procedure for Aircraft
FA6-91	Seams and Stitching
FA6-236	Attaching Sockets to Wire Ropes
FA7-16	Laminating Glass Fabric & Non-Metalic Sandwich-Low-Pressure
FA7-34	Laminating Temp. Resistance Polyester Resin
FA7-43	Laminating, Epoxide Resin. Cold curing, Non-Structural
FA507-3	Fabrication of Silicon Resin Impregnated Glass Fabric Laminates
FA507-5	Sheet Metal, Extrusion and Laminated Plastic
FP1-1	Sheet, Standard Detail
FP5-10	Application of Moisture & Fungus Resistance Coating

PROCESS SPECIFICATIONS (Continued)

Number	Title
LA0101-006	Instl of Gearings
LA9102-001	Fabrication of Details for Resistance of Welded Corrugated Metal Sandwich
LA9102-011	Cable Terminal Assy; Fabrication, Pre-Stretching and Proof Loading
LA0103-006	Thermal Cutting
LA9104-003	Marking of Parts and Assemblies
LA0104-005	Use and Application of Fluid Line System Ident. Markings
LA0104-005	Use and Application of Fluid line System I. D. Markings
LA0104-006	Rubber Stamp Marking; Application
LA 0104-012	Application of Decalcomanias
LA0106-006	Adhesive Bonding of Aluminum Alloy Assy's for Usage at -67 to 180°F.
LA0106-007	Adhesive Bonding of Thermosetting Plastics and Miscel. Materials for Usage from -67 to 180°F.
LA0106-023	Liquid Tight Sealing for Areas with Normal Temp. from -65 to 225°F.
LA0106-034	Use of Room Temp. Vulcanizing Silicone Rubber Adhesive
LA0111-006	Heat Treatment of Coating and Alloy Steels
LA0111-007	Heat Treatment of Titanium Alloy Sheet and Plate

PROCESS SPECIFICATIONS (Continued)

Number	Title
HA0109-006	Anodizing of Magnesium Alloys (Dow No. 17)
MA0101-001	Inst. 'l of Kelox Screw Threaded Inserts
MA0101-002	Inst. 'l of Helically Coiled Wire, Screw Thread Inserts
MA0101-003	Inst'l of Self-locking Clinch Nuts
MA0101-005	Inst'l of Threaded And Collared Fasteners
MA0101-006	Inst'l of Threaded and Collared Fasteners
MA0102-001	Fabrication and Inst'l of Rigid and Flexible Tube Extrusions
MA0102-002	Standard Details for Metal Sheet Extrusions
MA0103-005	Tolerances on Machined Parts
MA0105-002	Elev'd Temp. Restnt., Glass Fabric, Phenolic Lamits.'s, for Strut. Purposes
MA0105-006	Fabrication of Formed-In-Place Grommets and Cushions
MA0105-013	Compression Molded Parts, Phenolic Glass Fiber Filled.
MA0105-033	Fabrication of Flexible Polyurethane Foam Inserts
MA0106-001	Sealing of Pressurized or Fuel Compartments for Short Term Service at Temp.'s up to 400°F.
MA0106-002	Bonding Metallic and Metal Composite Structures with Heat Resistant Adhesive (300 to 500°F.)
MA0106-003	Bonding with Epoxypolymide Adhesive

[redacted]

PROCESS SPECIFICATIONS (Continued)

Number	Title
MA0106-008	Application of Metal Foil Nameplates
MA0106-017	Aerodynamic Smoothing with Flexible Joint Filler
MA0106-023	Bon. With Low Temp. Curing Adhesive for Serv. at -67 to 300°F.
MA0107-001	Fushion Welding
MA0107-004	Fushion Welding
MA0107-007	Brazing of Aluminum
MA0107-011	Furnace Brazing
MA0108-001	Polyurethane Coding
MA0108-002	Coating for Vibra. & Moisture Resistance
MA0108-005	Application of Organic Finishes, General
MA0108-006	Priming of laminated and Molded Plastic Surfaces
MA0108-009	Application of Epoxypolyamid Primer Coating
MA0108-012	Application of High Emitiance. High Reflectance White Temp. Control. Coating to Aluminum
MA0108-013	Application of Air Drying & Breaking Epoxy-amine Enamel
MA0109-002	Phosphate Coatings for Ferrous Metal
MA0109-003	Application of Chemical Films to Aluminum
MA0109-004	Electroless Nickel Plating

[redacted]

PROCESS SPECIFICATIONS (Continued)

Number	Title
MA0109-005	Repair & Refinishing of Abraded, Scratched, Rework corroded Metal Surfaces
MA0109-006	Cádmium Plat. Cyanide Process
MA0109-008	Cadmium Plat. Fluoborate Proless
MA0109-009	Chromic & Sulfuric Acid Antidizing
MA0109-010	Hard Crominum Plating
MA0110-001	Cleaning of Hose and Tube Assy.'s
MA0110-010	General Cleaning Methods
MA0110-011	Cleaning of Aluminum & Aluminum Alloys
MA0110-012	Cleaning of Iron & Steel
MA0110-013	Cleaning Corrosion & Heat Resistant Alloys
MA0110-015	Cleaning Titanium & Titanium Alloys
MA0110-018	Cleaning Components of Oxygen and Nitrogen Tetroxide Systems
MA0110-019	Cleaning of Copper & Copper Alloys'
MA0110-020	Abrasive Cleaning
MA0110-022	Cleaning Components of Pressurizing Systems
MA0110-024	Surface Preparation of Metals & Non-metals for Adhesive Bonding
MA0111-001	Heat Treatment of Ferrous & Non-Ferrous Alloys, General
MA0111-005	Heat Treatment of 18N; Maraging Steel

PROCESS SPECIFICATIONS (Continued)

Number	Title
MA 0112-003	Application of Solid Dry Film Lubricant
MA 0113-001	Electrical Bonding
MA 0113-002	Electronic Components & Hardware, Mounting of, Specification for
MA 0113-004	Wiring, GSE I.D. & Installation
MA 0113-006	Bonding, Elect., Aerospace Ground Eq.
MA 0113-007	Elect. Connector Aerospace GSE, Assy. of
MA 0113-010	Elect. Bond, Flight Vehicles
RA 0105-003	Plastic Tubing, Heat Reactive Inst'l
RA 0106-003	Use of Room Temp. Cured Contact Resin Adhesive for Non-Structural Parts
MP 050-0001	Weld Symbols
MP 121-0001	Code Rivet

PROCESS SPECIFICATIONS (Continued)

Section II

Number	Title
MA0201-0005	System Checkout Console (C14-019
MA0201-0006	Antenna Equipment, Apollo R&D Telemetry Electrical Requirements and Checkout Procedures for
MA0201-0007	Breadboard Checkout
MA0201-0008	Drawer Assembly System Monitor, Rev. A (C14-019)
MA0201-0012	Test Conductor Console Assembly Functional Test Procedure (C14-019)
MA0201-0014	Test Conductors Master Power Panel Assembly Functional Test Procedure for (C14-019)
MA0201-0015	Signal Conditioner Console (C14-135)
MA0201-0016	Launch Control Drawer Assembly Functional Test Procedure for (C14-019)
MA0201-0017	Relay Driver Assembly (C14-135)
MA0201-0019	Data Recording Group (C14-020)
MA0201-0020	Mobile Data Recorder Panel Assy. Patchboard
MA0201-0021	Procedure for Continuity Checkout
MA0201-0024	Command Module Substitute Unit
MA0201-0025	Hot Bridgewire Simulator and Decision Circuit (P/O A14-003)
MA0201-0026	S/C Weight and Balance
MA0201-0028	Board Recorder Checkout Unit (C14-031)

PROCESS SPECIFICATIONS (Continued)

Number	Title
MA0201-0029	Launch Vehicle Substitute Unit
MA0201-0032	Launch Escape Sequencer Bench Maintenance Equipment
MA0201-0033	Pyrotechnics Maintenance Equipment (C14-051)
MA0201-0034	Isolation Amplifier Assembly (P/O C14-135)
MA0201-0035	Junction Box Assembly (C14-169)
MA0201-0037	Antenna Checkout Group (C14-032
MA0201-0038	C-Band Radar Transponder Checkout Unit Functional Test (C14-112)
MA0201-0039	Junction Box Assembly Pad (C14-172)
MA0201-0041	Control Power Panel Assembly (C14-020)
MA0201-0042	Junction Box Assembly (C14-136)
MA0201-0043	Junction Box Assembly Umbilical Functional Test Procedure for (C14-171)
MA0201-0044	Junction Box Assembly Umbilical (C14-170)
MA0201-0045	Pyrotechnics Simulator Control (A14-003)
MA0201-0046	Junction Box Assembly (C14-171)
MA0201-0056	Integrated Sys. Checkout Requirements for Boilerplates
MA0201-0058	Inter. System C/O Procedure for Boilerplate 12
MA0201-0109	Drawer Assy. Sys. Monitor Functional Test Procedure
MA0201-0200	Electrical Systems Insulation Resistance and Continuity Check Procedure for

PROCESS SPECIFICATIONS (Continued)

Number	Title
MA 0202-0006	Fwd. Compartment Heat Shield-Separation System
MA 0202-0008	Forward Compartment Heat Shield Separation System
MA 0202-0010	Forward Compartment Heat Shield Separation System
MA 0202-0011	C/M Service Module Separation System
MA 0203-0001	EBW Firing Unit, Launch Escape Systems, Handling
MA 0203-0002	Battery, Storage, Silver Oxide Zinc Mar 4090 Handling, Activation, Charging and Checkout of
MA 0203-0004	Battery, Storage, Silver Oxide Zinc Mar 4095 Handling, Activation, Charging and Checkout of
MA 0203-0009	Junction Box (JB02) OP C/O
MA 0203-0012	Antenna Equipment, Apollo R&D VHF Omni-Electrical Requirements and Checkout Procedures for Boilerplate 12, 13, and 23
MA 0203-0013	Antenna Equipment, Apollo R&D Beacon-Electrical Requirements and Checkout Procedures for
MA 0203-0019	Bread Board Test, Pyrotechnic System for Boilerplate 12
MA 0204-0007	Procedure of Calibration of NASA type No. 2.7.1.0.0 Pressure Transducer
MA 0204-0010	Procedure for Calibration of NASA Type No. 2.8.1.1.0 linear Accelerometer

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PROCESS SPECIFICATIONS (Continued)

Number	Title
MA 0204-0012	Timer (Gulton) OP C/O
MA 0204-0022	Calibration Signal-Cond. Box Resistor Net-WK
MA 0204-0029	Electrical Verification of FM Power Checkout
MA 0205-0001	R.F. Coaxial Cable RG115 A.U., RG142. U, RG142A/U, RG115/U, Electrical Requirements and Checkout procedures for
MA 0205-0002	Coaxial Cables, RG-115 A/V and RG-142 A/V Test Procedures
MA 0205-0005	Relay Box. Launch Escape Sequencer, Elect. Control, Checkout Procedure for
MA 0205-0007	R&D Telemetry System Checkout Requirements
MA 0205-0009	R&D C-Band Transponder System Checkout Procedure
MA 0205-0010	Boilerplate Numbers 12 and 23 Relay Box, Electrical Control Checkout Procedure for
MA 0205-0037	B/P 12, 22, 23 Tower Sequencer Assy, Electrical Control, Flight Worthiness Test, Procedure for
MA 0205-0038	B/P 12, 22, 23 Tower Sequencer Assy, Electrical Control, Flight Worthiness Test, Procedure for
MA 0206-0003	Integrated R&D, Cooling Systems, Checkout Procedure for
MA 0208-0001	Parachute Sub-System, Earth Landing System
MA 0209-0001	Apollo Windows, Optical Requirements Specification
MA 0209-0002	Apollo Windows, Structural Test Specification

[redacted]

PROCESS SPECIFICATIONS (Continued)

Number	Title
MA 0210-0006	Launch Escape System Assembly & Checkout
MA 0210-0012	Launch Escape System, Assembly and Checkout
MA 0301-0001	Test and Calibration Procedure Mag. Tape Recorder
MA 0302-0002	Fluctuating Pressure (Statham) Calibration
MA 0302-0003	Ordnance Equip: Handl., Storage & Inspection Procedure
MA 0303-0001	Apollo Boilerplate Umbilical Connector, Assembly of
MA 0303-0002	Cable, Apollo Boilerplate Launch Escape Motor Looming of
MA 0303-0003	Apollo Boilerplate Umbilical Connector, Assembly of
MA 0303-0004	Calibration Pwr. - Control Box Current Shunt
MA 0303-0006	Color Coding of Electric Connectors, Procedure for
MA 0303-0031	Electrical Wiring, Assembly and Installation of
MA 0303-0032	Electrical Connector Assemblies Assembly of
MA 0303-0033	Electrical Wires and Connectors Storage of
MA 0303-0034	Crimp Style Terminals on Electrical Wiring Installation of
MA 0303-0035	Shielded Cable, Fabrication of
MA 0304-0001	Timer (Gulton) Calib.
MA 0304-0003	Amplifier Calibration

PROCESS SPECIFICATIONS (Continued)

Number	Title
MA 0304-0006	For Handling Inspection and Storage of Pitch Control Motors
MA 0304-0007	Procedure for Calibration of Donner Model 4310 Linear Accelerometer
MA 0304-0008	Temperature, Transducer, Micro Systems, W1-W2.
MA 0304-0010	NASA Type Vibration Systems
MA 0305-0001	Coaxial Cables and Connector, Assy. of Bendix Checkout Procedure, Bendix T/-136
MA 0305-0002	Telemetering Transmission Sys. Modulation Package
MA 0305-0004	F-16A Nortronics Q-Ball Functional & Calibration Prodecure
MA 0306-0006	Installation Procedures for Integrated R&D Cooling System
MA 0308-0006	Alignment and Assy. Procedure
MA 0308-0013	Ordinance Installation Command Module Service Module Separation
MA 0308-0014	Ordinance Installation Procedure Tower C/M Separation System
MA 0310-0001	Insulation, Buna-N Rubber Launch Escape System, Applicable of
MA 0310-0002	Protective, Ozone and Weather Resistent, Launch Escape Tower CM Applicable of
MA 0310-0003	Insulation, Thermolog T-500, Launch Escape System, Application of

PROCESS SPECIFICATIONS (Continued)

Number	Title
MA 0310-0004	For Handling Inspection and Storage of Tower Jettison Motors
MA 0310-0005	Handling, Inspection & Storage of Tower Jettison Motor
MA 0310-0006	For Handling Inspection and Storage of Pitch Control Motors
MA 0405-0001	Boilerplate Number 12 Relay Box, Electrical Control, Environmental Test, Procedure for
MA 0406-0001	Pressure Leak Rate Test for Boilerplate C/M
MA 0410-0001	LES Post Flight Recovery & Inspection
MA 0606-001	Potting Elect. Wiring Tower Sturct. Apollo Launch Escape System
MA 0606-002	Bonding of Wiring Harness Apollo LES

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APPENDIX C

MATERIAL SPECIFICATIONS

1. Scope. - The following list constitutes the material specifications for Boilerplate Number 12.

Number	Title
LB 0140-002	Coating Solid Dry Film Lubricant, High Temperature 700° F. Maximum
LB 0160-147	Steel, 350 Alloy, Corrosion Resistant Hydraulic Tubing
LB 0170-110	Weldable Titanium Alloy YI-SA1-Z. 5SN ELI Extra Low Interstitial Bar Billets and Frog
LB 0170-113	Solder, Tin-Silver Alloy
LB 0170-147	Titanium Alloy; (6AVI-4V) Bars, Rods and Shapes
MB 0130-007	Glass Fabric, Polyester Resin-Pre-impregnated
MB 0150-005	Cable Elect., Shielded & Jacketed
MB 0160-006	Marging Steel, Bar, Extrusions, Forgings, & Forgin Stock, Precipitation Harding (18Ni-9CO-5Mo-0.5T-0. -10Al)
MB 0170-008	Structural Tubing, 6A1-4V Titanium Alloy Welded

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APPENDIX D
PROCUREMENT SPECIFICATIONS

1. Scope. - The following list constitutes the procurement specifications for Boilerplate Number 12.

Number	Title
MC111-0001	Bolt Assy. Explosive, Elect, Initated
MC 111-0004	Bolt Assy. Dual Mode Elect. Initated
MC 411-0004	Cgl. & CGL. Assy. Spec. Purp. Elect. Apollo GSE Gen. Procurement Specification
MC 453-0005	Cartridges, Assy Elect. Initated, Pressure Hotwire
MC453-0011	Detonator Cartridge Assy, Elect. Initated, Hotwire
MC453-0014	Igniter Cartridge, Hotwire, Elect. Initiated
MC481-0001	Antenna System R&D Telemetry
MC481-0003	R&D Beacon Antenna
MC901-0001	Apollo Earth Landing System - Parachute Sub-System
MC901-0002	Rocket Motor, Solid Propellant, Apollo, Launch Escape System
MC901-0014	Test Fixture, Q-Ball
ME 127-0004	Support Line
ME128-0001	Blind Rivet Threaded -1000 Flat Hend
ME128-0002	Blind Rivet, Threaded - Hex Head
ME 181-0026	Case Instrument
ME 183-0006	Adapter Assy. Launch Escape Motor

PROCUREMENT SPECIFICATIONS (Continued)

Number	Title
ME187-0007	Not Released
ME194-0001	Not Released
ME 273-0006	Not Released
ME 281-0005	Pump Assy. Environmental System
ME402-0007	Generator, Pulse
ME411-0105	Cable Assembly
ME 435-0015	Recorder Analog, Eight Channel
ME901-0129	Junction Box, Trailer No's 1 and 2
ME901-0130	Junction Box; Pad No.'s 3 and 4

APPENDIX E
FLIGHT HARDWARE (NASA Furnished)

Component	Vendor	Vendor No.	EBS Drawing No.	NASA Type No.	Range	Quantity Flt.	Quantity Spare
Telemetry R. F. Pkg.	Bendix	TATP-316	SD-510, 044C SD-530, 136A	4. 12. 1. 1. 4	-----	1	1
T-M Subcarier Assy.	Bendix	TATP-316	SD-510, 043B SD-530, 135A	3. 8. 1. 1. 1	-----	1	1
Timer	Gulton	CGT-100	SC-510, 092 SX-520, 018A	5. 2. 1. 1. 0	-----	1	0
D. C. Amplifier Rack	NASA	2-M#6	SD-510, 053B SB-530, 111E	5. 13. 1. 1. 2	-----	9	2
Tape Recorder	Leach	MTR-1200	SD-510, 040A SE-520, 015A SC-530, 144A	5. 1. 1. 1. 2	------	1	0
Signal Conditioning Box	NASA Brown	CH-150	SD-510, 063C SX-530, 059A	2. 12. 1. 1. 0	------	1	0
Rate Gyro	U. S. Time	400455	SD-510, 030B SD-530, 130A	2. 3. 2. 1. 2	$\pm$ 60°/sec	1	1
Attitude Gyro	Giannini	3416 DV-06	SC-510, 075 SC-530, 153	2. 4. 1. 1. 1	$\pm$ 175°	3	1
Main Battery (120 Amp.Hrs)	Eagle Picher	MAP-4095-3	SD-550, 0404 SD-550, 040A	1. 1. 1. 3. 0		1	1
Pyro Battry (5 Amp. Hrs.)	Eagle Picher	MAR-4090-3	SD-550, 041A SD-550, 041A	1. 1. 1. 1. 0		4	2
Acc. Transducer	Donner	4310	SB-510, 021A SB-530, 010	2. 8. 1. 1. 7	-10G +20G	1	1
Acc. Transducer	Donner	4310	SB-510, 021A SB-530, 010	2. 8. 1. 1. 5	$\pm$10G	4	2
Acc. Transducer	Donner	4310	SB-510, 021A SB-530, 010	2. 8. 1. 1. 1	$\pm$ 2G	1	1

APPENDIX E (Continued)
FLIGHT HARDWARE

Component	Vendor	Vendor No.	EBS Drawing No.	NASA Type	Range	Quantity	
						Flt.	Spare
Transducer	Statham	PA-288TC	SD-510,064A SD-530,016	2.7.2.3.1	0-15PSIA	12	4
Amplifier	Eng. Mag.	2000 D-1	SD-510,060A SD-530,091	2.11.1.1.2	-------	12	4
Pressure Transducer	Wiancko	P2-3236-1	SB-510,022A SC-530,157A	2.7.1.4.1	0-15PSIA	1	1
Pressure Transducer	Wiancko	P2-3136-2	SB-510,022A SC-530,157A	2.7.1.2.1	0-2500PSID	2	1
Pressure Transducer	Wiancko	P2-3136-3	SB-510,022A SC-530,157A	2.7.1.5.1	2-15PSIA	4	2
Pressure Transducer	Wiancko	P2-3236-3	SB-510,022A SC-530,157A	2.7.1.5.3	2-22PSIA	36	4
Power Control Box	NASA	PC-3	SB-510,051B SX-540,009	1.5.1.1.0	--------	1	0
Junction Box	NASA	JB-1	SD-510,056B SB-530,169 SC-530,134C	1.8.1.1.0	--------	1	0
D. C. Amplifier	EM	2000D-1	SD-510,060A SD-530,089	2.11.1.1.1	--------	1	1
C-Band Transponder	Motorola	AN/DPN66	SC-510,036 SB-510,216 SX-530,075	4.4.2.1.0	--------	2	1
Resistance Thermometer	Transonics	T4082C-8	SC-550,000 SC-550,000	2.24.2.3.1	0-150°C	1	1
Amplifier	EM	2000A-3	SB-510,060A ----------	2.11.1.2.1	--------	1	1
Resistance Thermometer	Transonics	2168A	SB-550,001 SB-550,001	2.24.2.1.1	-50 -175°C	2	2

APPENDIX E (Continued
FLIGHT HARDWARE

Component	Vendor	Vendor No.	EBS Drawing No.	NASA Type No.	Range	Quantity Flt.	Quantity Spare
Amplifier	EM	2000A-3	SB-510, 060A ----------	2.11.1.2.1	-----	1	1
Resistance Thermometer	Trans-onics	2168A	SB-550, 001 SB-550, 001	2.24.2.1.1	-50 -175°C	2	2
Amplifier	EM	2000A-3	SB-510, 060A ----------	2.11.1.2.1	-----	2	2
Q-Ball	Nortronics	F-16A	Nortronics No. 22620042	NAA ME901-0014	±40° 0-1250 PSF	1	1
Bridge Adjustment Unit	Microdot	401-0110-1	SD-510, 083A SD-530, 028	2.13.1.1.1	-----	1	0
Commutator & Amplifier		5D LDA12N-432	SC-510, 097 SB-530, 074	3.1.2.1.1	-----	1	0
Thermostatically Controlled Box	NASA	HB-1	SD-510, 177 SB-530, 064		0-200°C	1	0
Thermostatically Controlled Plate	NASA	HP-1	SD-510, 177 SB-530, 064		0-200°C	1	0
Pyro Battery (5 Amp.-Hrs.)	Eagle Picher	MAR4090-3	SD-550, 041A SD-550, 041A	1.1.1.1.0	-----	1	0
Resistance Thermometer	Transonics	T4082C-8	SC-550, 000 SC-550, 000	2.24.2.3.1	0-150°C	21	0
Thermocouple	Fenwall	SK3047	SC-550, 002 SC-550, 001	2.23.2.2	0-300°C	20	0
Zone Boxes	Microdot	401-0138-1	SC-550, 008 SC-550, 001	2.25.1.1.1	-------	20	0

Component	Vendor	Vendor No.	EBS Drawing No.	NASA Type No.	Range	Quantity Flt.	Quantity Spare
Pyro Battery	Eagle Picher	MAR4090-3	SD550,041A SD550,041A	1.1.1.1.0	-----	3	1
Camera	Milliken	DBM-5A	SD510,217 SC530,173	5.1.2.1.1.0	-----	3	1
Tri-pulse Generator	Stienwood	1110	---------- ----------	----------	-----	3	1
Inertia Switch	Inertia Switch Co.	6UO-115	---------- ----------	----------	-----	3	1
Camera Control Unit *	NAA	------	B15-750317 ----------		------	3	1
Antennas *	Transco	------	NAA/B16-710, 012A	ME481-0001-0001	------	4	0
Power Divider *	Transco	------	NAA/B16-710, 012A	ME481-0001-0003	------	3	0
Antennas *	Melpar	-------	NAA/B16-710, 012A	ME481-0003-0001	------	4	0
Power Divider *	Melpar	-------	NAA/B16-710, 012A	ME481-0003-0002	------	2	0
Pressure Transducer	Wiancko	P2-3236-1	SB510022A SC 530,157A	2.7.1.4.1	0-15 PSIA	8	2
Relay Box	NASA	RB-1	---------- ----------	1.10.1.1	------	1	0
Pressure Transducer	Wiancko	P2-3136-1	NAA/B14-750, 100	----------	0-15 PSIA	1	2
Temperature Transducer	Micro Systems	TS02G-C1-W2-10	NAA/B14-750, 103	----------	0-200°F	2	1

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